# ENGINEERING LITERATURE

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Owing to the pressure of reviews and notices on our space this month the usual editorial comments and several communications are omitted.

## REVIEWS.

### Two Books on Concrete and Cement.

CEMENT AND CONCRETE.—By Louis Carlton Sabin, B. S., C. E., Assistant Engineer, Engineer Department, U. S. Army. New York: McGraw Publishing Co. Cloth, 6 x 9¼ ins.; pp. 507; one diagram, 161 tables and 16 figures in the text. $5.

A TREATISE ON CONCRETE, PLAIN AND REINFORCED—Materials, Construction, and Design of Concrete and Reinforced Concrete. With Chapters by R. Feret, William B. Fuller and Spencer B. Newberry. By Frederick W. Taylor, M. E., and Sanford E. Thompson, S. B., Assoc. M. Am. Soc. C. E. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6 x 9 ins.; pp. 585; 176 figures in the text. $5.

There has been for some years a paucity of up-to-date books on hydraulic cements and concretes. This statement does not mean that there is any lack of literature on these subjects nor that the publishers' lists do not contain books devoted to them. Indeed, the case is the exact contrary. There is plenty of literature relating to cement and cement products and a score of books which make these materials the subject of their text, but the books are not up-to-date in the knowledge of their subject and the literature which really deserves this characterization is scattered through the engineering periodicals and society proceedings and is out of convenient reach for most engineers. Naturally this condition of affairs has not been overlooked by authors and publishers, and the output of "cement books" within the last few months indicates clearly that they have set at work to remedy it. Two of these new books are now before us. Both are general treatises on cements and cement products—mortar and concrete; and both lay claim to unusual research and endeavor to bring before engineers the latest knowledge concerning the uses and properties of hydraulic cements.

Starting with practically the same purpose in view, the two authors have sought their results in different ways. Mr. Sabin has depended largely on his own unaided endeavors to cover the field set before him, while Mr. Thompson has collaborated with a number of experts in producing his work. Generally speaking, Mr. Sabin's book elaborates the subjects of cement testing and the properties of cements while Mr. Thompson's gives first place to the manufacture and uses of concrete, its composition, mixing, physical properties and placing. Another broad difference between the two books consists in the sparing use of illustrations by Mr. Sabin, while Mr. Thompson presents nearly 200 of these aids to the text. In typography, paper and printing there is little to choose between the two books; both are good examples of technical book making and both are provided with satisfactory indexes. In addition, Mr. Thompson has given a very useful bibliography of books and papers on cements and concretes.

Considering first the raw material, cement, as distinguished from the products, mortar and concrete, we can divide the text of both books into two parts; the first treating of the classification, manufacture and properties of hydraulic cements and the second discussing cement testing. In their classification of hydraulic cements the two books follow about the same lines, Mr. Sabin's presentation being rather more complete than Mr. Thompson's, particularly in respect to the wide variety of European natural cements and hydraulic limes. Neither Mr. Sabin nor Mr. Thompson covers the subject of cement manufacture at all satisfactorily; of the two, Mr. Thompson's presentation is the more useful. It is, of course, a question just how much elaboration is warranted in a general treatise in presenting processes of manufacture, but there is no excuse either for misleading statements or broad generalities that tell nothing. We find both of these faults in the books before us. In Mr. Sabin's chapter particularly, considering the brief space allotted to the subject, it is hardly more than idle time to rehearse methods of the semi-wet process and descriptions of vertical and ring kilns. Neither the semi-wet process nor these types of kilns are used in America, except in isolated cases and in mills built before the rotary kiln had been developed. A person knowing nothing at all of the subject of cement manufacture as it is practiced in America would leave the perusal of Mr. Sabin's chapter with an entirely wrong impression of his subject. Mr. Thompson does much better in confining his presentation chiefly to rotary kiln processes, and relegating other processes to a subordinate position. A point upon which neither author touches and upon which civil engineers often desire information is rough methods of prospecting and sampling possible deposits of raw materials for cement manufacture.

Turning now to the examination and testing of cements to determine their suitability for engineering works, we come first to chemical analysis and composition. The chapter on this topic in Mr. Thompson's book was prepared by Mr. Spencer B. Newberry, while that in Mr. Sabin's book is the work of the author himself. Both chapters are satisfactory in their statement of the component ingredients of cement and the roles played by them, and that by Prof. Newberry is particularly interesting for its discussion of rules for proportioning the ingredients in Portland cement manufacture. Neither book presents methods for chemical analysis or discusses adequately the constitution of cements.

In discussing the physical tests of cements, Mr. Sabin's book leads in the extent and in the value of the matter presented. The field covered by the two books is about the same and includes tests for density, fineness, activity, cohesion, shear, abrasion, compressive strength, etc. In general both books fail in the matter of instructing the green hand at cement testing; no instructions in detail are given of the manipulation of cement tests and testing apparatus, and as to the errors commonly made, their significance and how to avoid them. With these restrictions in mind, it can justly be said that both books are far superior to anything that has heretofore been published in book form on cement testing, and that of the two, Mr. Sabin's book gives the most thorough and comprehensive treatment.

Passing to those chapters in the two books which relate to the strength and physical properties of cements, mortars and concretes, we find Sabin's work much the better. Indeed, Sabin's book might with propriety be given the title "The Physical Properties of Cement and Concrete," since so large a percentage of space is devoted to testing and the results of tests.

The authors of both books have given quite a large number of their own tests, but Mr. Sabin has been more thorough in abstracting and summarizing the tests of other men. One of the most serious criticisms of the work of Mr. Thompson and his collaborators is the meager space given to the results of other workers in the cement testing field. Furthermore, much is given that is of questionable value relating to the theory of the proportioning of concrete to secure the greatest strength. Mr. Fuller's parabolic theory, for example, should at least have been subjected to the fire of criticism in the transactions of an engineering society before its presentation in a text-book. Mr. Feret's theory has the merit of having been published before, but aside from the fact that it conflicts with Mr. Fuller's theory, it appears not to be logically derived. To illustrate this point we select an example given on page 135 of Taylor and Thompson. A mortar is made as follows:

| | |
|---|---|
| Cement (c) | = 0.226 |
| Sand (s) | = 0.499 |
| Water (w) | = 0.234 |
| Air voids (v) | = 0.041 |
| Total volume (c + s + w + v) | = 1.000 |

The authors state that the porosity of this mortar,

represented by the sum of the water and air voids, is 27.5%. The density of the mortar considered above is c + s, or 0.220 + 0.499 = 0.725, as given in column (11) of the table.

The authors have made a curious error in reasoning, which vitiates all conclusions based upon the so-called "density" of the mortar. The error lies in their failure to perceive that when the cement sets (i. e., crystallizes) it takes up a large part of the water as water of crystallization—in other words, the water becomes an integral part of the mortar, and adds to its density. The voids in the solidified mortar are, therefore, not 27.5%, but considerably less.

The specific gravity of the particles of dry Portland cement is about 3.1, but the specific gravity of particles of three-day old solidified cement mortar made with 15% of water is about 2.75 (see Falk's "Cements, Mortars and Concretes," p. 10). This could be true only on the assumption that the water unites with the cement to increase its bulk, reducing its specific gravity in proportion to the relative weights of cement and water uniting. There is, then, no truth in the statement that the density of a mortar is c + s, or 0.725, as in the case above given. Nevertheless, the authors proceed as follows:

> The value of determining the density of mortars is made evident by the following law of Mr. Feret:
>
> For any series of plastic mortars made with the same binding material and inert sands, the resistance to compression after the same length of set, under identical conditions, is solely a function of the ratio $\frac{c}{w+v}$, or $\frac{c}{1-(c+s)}$, whatever be the nature and size of the sand and the proportions of the elements—cement, inert sand and water—of which each is composed.
>
> From very numerous experiments such as these tabulated on page 136, Mr. Feret evolves the approximate formula
>
> $$P = K\left(\frac{c}{1-s}\right)^2$$
>
> P = compressive strength of the mortar.
> K = 28,000, if the strength is in lbs. per sq. in.

Then the authors add that the formula is inapplicable to tensile tests, although "the general principle appears to hold good." We would call attention to the fact that the "approximate formula" does not contain the factor c in the denominator, yet, if the "law" announced by Mr. Feret is true, c is not infinitesimal in mortars of ordinary richness and should not be dropped. The "approximate formula" fits Mr. Feret's compressive tests, but, as most of the tests of other experimenters are tensile tests, it is difficult to

establish its general applicability. The same criticism applies to the parabolic theory advanced by Mr. Fuller in a subsequent chapter, for all his tests are tests of transverse strength, made on concrete beams 6 × 6 × 72 ins. Mr. Fuller developes an elaborate theory for the proportioning of ingredients to secure the maximum strength for any given percentage of cement to be used. But the structure of his theory stands on the comparatively few experiments made by him. It may or it may not prove tenable when examined by other experimenters.

The authors state that Mr. Fuller's theory

> appears on its face to conflict with Mr. Feret's conclusion that the best mixture of sand and cement for mortar is made up of coarse and fine grains only, with no intermediate grains. For sand mortars, Mr. Feret's methods are undoubtedly more exact than Mr. Fuller's, but for a concrete mixture the conditions are different, and more than two sizes of materials are theoretically necessary for obtaining the densest mixture. The best proof of the practical efficiency of Mr. Fuller's method lies in the fact that he has employed it day after day for determining the proportions of the aggregate for concrete used in constructing thin, watertight walls. The method is exact and scientific and not "rule of thumb."

If "the best proof" of the truth of Mr. Fuller's theory lies in the fact that he has used it in proportioning concrete, we fear that it stands upon no better footing than any of the "rules of thumb," for they too have received the same kind of demonstration—namely, application by the originator of the rule.

Passing to the discussions of the quantities of materials required to make a cubic yard of mortar or concrete, we again find Mr. Sabin's book somewhat more satisfactory, even if not so pretentious. Mr. Sabin offers no formula for determining the amount of cement in any given mixture, but gives tables of actual quantities of cement required for both natural and Portland mortars up to 1 to 6 mixtures of cement and sand. He fails, however, to state what brand of cement was used in making these tests, which is a very important factor, as comparison with the table of actual tests by Mr. Fuller shows. Mr. Sabin's Portland cement barrel made 3.65 cu. ft. of cement paste, whereas Mr. Fuller's barrel made only 3.4 cu. ft. of paste. The most elaborate tables that we have ever seen for determining the amount of cement in different proportions of concrete are to be found in Taylor and Thompson's book. But they are useless except for one who is using a cement barrel that yields practically 3.4 cu. ft. of paste, and a sand containing 46% voids. This is particularly noteworthy since the authors present formulas intended to give accurate results for all sizes of cement barrels. They have fallen into a curious error of logic, however, in developing and applying their formula. For, after giving a correct general formula they introduce one incorrect assumption and one specific assumption that limits the generality. The assumption that we believe to be incorrect is stated as follows:

> For different proportions of the same cement and sand, the sum of the water and the air voids in the mortar is a constant.

But even granting the truth of this statement, the next step robs the formula of its generality, for the authors insert certain constants in the general formula, which constants depend on using a barrel of the size used by Mr. Fuller, namely, one yielding 3.4 cu. ft. of cement paste. Then, after thus limiting the generality of the formula, tables are deduced giving the quantities of cement for different sizes of barrels! Without reproducing the mathematics it is difficult to indicate the peculiar fallacy into which the authors have fallen, but since the best test of such a formula is a comparison with actual tests, we shall quote from one of Taylor and Thompson's tables (based on the formula), and from one of Sabin's tables (based on Sabin's tests), as follows:

| Prop'n. cement to sand.. | 1to0 | 1to1 | 1to2 | 1to3 | 1to4 |
|---|---|---|---|---|---|
| Sabin (3.65 cu. ft. per bbl.) | 7.4 | 4.17 | 2.84 | 2.06 | 1.62 |
| T. and T. (3.50 ft. per bbl.) | 8.31 | 5.22 | 3.51 | 2.64 | 2.12 |
| T. and T. (3.80 ft. per bbl.) | 8.31 | 5.01 | 3.32 | 2.48 | 1.98 |

Taylor and Thompson do not give any tabular data for a barrel of 3.65 cu. ft., but we have quoted data (for 3.5 and 3.8 cu. ft. per bbl.), the mean of which may be taken without serious error for comparison with Sabin's results. For a 1 to 2 mortar we see that Sabin's tests give 2.84 bbls. of cement per cu. yd.; whereas Taylor and Thompson's formula gives approximately 3.4 bbls.—a difference of 0.54 bbl., or about 20% more cement than given by Sabin! Remember that we are criticising a formula ostensibly general, and that we are not merely comparing the tests of two different experimenters. If these data of Sabin's be called exceptional (and we do not believe that they are), still it must be borne in mind that an exception does not "prove the rule" in physical investigations, but utterly discredits the rule.

We have dwelt somewhat at length upon the subject of concrete proportions, not only because of the dollars and cents importance of the subject, but because these two books will be widely used; and, if their data and doctrines are accepted without careful scrutiny, serious blunders in estimating costs may be made.

We come now to those chapters in which the methods and costs of making concrete are given. So far as the mere text is concerned there is little to choose between the two books; Sabin being, however, more concise but not so satisfactory as Taylor and Thompson on the fabrication of concrete. But the feature that will strike every purchaser of Sabin's book is its barrenness of illustrations. In a book of 500 pages there are only 16 cuts, and nine of these illustrate cement testing, the remaining seven showing the stresses in a reinforced concrete beam. Taylor and Thompson, on the other hand, have 176 illustrations. It is true that a large percentage of these are photographs and catalogue cuts, but there are a number possessing merit, although on the whole the illustrations are very unsatisfactory, considering the wealth of such matter that has appeared in technical journals.

As regards the cost of making concrete neither book is satisfactory. Sabin gives the larger number of illustrative cases. Taylor and Thompson do not give a single example of the detailed cost of machine mixing; the nearest approach to giving such information being found on page 363, where the number of men in a gang operating a paddle mixer is given. Contractors having any experience will be disappointed in the cost data given in either book, and contractors having no experience will be confused rather than enlightened.

That important item, cost of forms, is scarcely touched upon, and, when it is mentioned, the reasons for the wide variations in cost are not discussed. Taylor and Thompson give very few illustrations of the construction of forms, and Sabin gives none. However, the text describing the construction of forms is satisfactory in both books. So likewise is the text describing the manipulations in making concrete for various purposes.

Regarding the construction of concrete buildings, Sabin has only 10 pages (no illustrations), while Taylor and Thompson have 21 pages, including 9 illustrations.

On reinforced concrete, Sabin gives 29 pages, 20 of which are devoted to the discussion of the theory of the beam; while Taylor and Thompson have 50 pages, of which 46 pages are devoted to the theory of the beam and to tables to be used in beam design. In addition to this, Taylor and Thompson have some matter on reinforced concrete in the chapter on buildings above mentioned, and about 8 pages on reinforced dams, conduits, sewers, and arches. A statement of these facts makes it apparent that neither book makes any serious pretence of treating reinforced concrete, although the term "reinforced" appears in the title of one of the books. So far as the discussion of the beam is concerned, both books appear satisfactory. As illustrating the present unsettledness in concrete nomenclature, it is interesting to note that Sabin uses the term concrete-steel, whereas Taylor and Thompson use reinforced concrete.

In conclusion we wish to make it distinctly understood that these two books are the most comprehensive reference books in English on the subject of plain concrete construction, although each shows faults of omission and commission. They contain in convenient form much of the valuable matter that has appeared in periodicals and transaction during the past fifteen years.

## Mechanics for Beginners.

ELEMENTS OF MECHANICS.—Forty Lessons for Beginners in Engineering. By Mansfield Merriman, Professor of Civil Engineering in Lehigh University. New York: John Wiley & Sons. Cloth; 5 × 7½ ins.; pp. 172; 142 illustrations in the text. $1.

A good book for beginners, practically the only one of its kind in American technical literature, is here brought before us. The book is well suited for self-study, a purpose which is in part carried out by restricting the mathematical analysis to the methods of simple algebra and plane trigonometry.

It is intended for manual-training schools, for classes in engineering colleges, and for young men in general who have the preparation just indicated.

The last-named class properly includes the large army of young men who desire to learn the principles of engineering science though they have not the help of a technical college. And this class of men strongly needs Mechanics—the underlying science of all engineering work—and needs it only the more because the science merely puts into systematic and fruitful form a series of principles based on observation and intuition.

The author's suggestion that a course such as he presents should be worked through in the first year at technical colleges, preliminary to a more analytical study of mechanics, after calculus has been passed, is an attractive one. There are students who after graduation are able, and bold enough, to treat a problem of Applied Mechanics by second differentials without giving regard to the conditions of force equilibrium. An action of this kind would be much less likely if the student in question had early gone through an elementary course in Mechanics, a course where principles are more prominent than are difficulties of mathematical method. Such a course is generally included in courses of Physics; but taught there, it never receives the interest and attention on the part of the students that it requires.

The following are the subdivisions of the book: Concurrent forces; Parallel forces; Center of gravity; Resistance and work; Simple machines; Gravity and motion; Inertia and rotation. The text treatment progresses in simple and consistent manner, care being taken at every new principle to connect it with common experience. A group of problems follows each article of text, the whole book containing no less than 400 problems. Answers to about half of these are collected in an appendix.

No attempt is made to teach graphical methods of force analysis. Diagrams are used, of course, as aids in explaining various algebraic expressions, but, except as these suggest the possibility of graphical solution, nothing but algebraic analysis is taught by the book. The argument against this limitation is probably more evident than the argument in favor. The latter is this: graphical analysis adds nothing to the principles taught or the scope of the analysis, while on the other hand it entails careful instruction in the mechanical procedure and sequence of graphical operations. Where the entire treatment is to be closely limited in bulk and effort, therefore, the inclusion of graphical analysis is a disadvantage. This applies directly in the case of the present work, which is confined within 162 reading pages, of which nearly one-fourth is taken up by problems. The brevity and compactness of the work is one of its distinguishing advantages.

## Combustion in Gas Producers and Boiler Furnaces.

GENERATOR, KRAFTGAS-UND DAMPFKESSEL-BETRIEB in bezu auf Wärmeerzeugung und Wärmeverwendung. By Paul Fuchs. Berlin: Julius Springer. Cloth; 5 × 8 ins.; pp. 42 Figures in the text.

This book is in part a second edition of the author's work on "Heat Production and Utilization in Steam Boiler Operation." In response to requests for a consideration of fuel utilization by other means than the boiler furnace, a discussion of gas producer working was incorporated with the original matter, so that the scope of the work has become materially enlarged.

The book is divided into three parts, which may be given the headings Combustion, Heat Transmission and Operative Testing, respectively. The first part considers the chemical procedure going on in the combustion of fuels, whether partial combustion as in the gas producer or the

(theoretically) complete combustion in boiler furnaces. Formulas are derived for required amount of air, composition and heating value of products, due regard being had to the temperatures at which the processes go on. The second part discusses transmission of heat through heating surfaces, as to distribution, efficiency, etc. The third part describes the various instruments required for measurements of temperature, gas pressure (draft, etc.), and composition, and explains how these should be used to furnish a continuous index of the operation of furnace or producer.

In the latter portion of the text special stress is laid on the value of a differential manometer. By using such an instrument, either in indicating or in recording form, to register the density of the gas made in a producer, a satisfactory record is obtained of the extent to which abnormal reactions—due, for example, to excess or deficiency of air supply—are going on. The author shows that a close relation exists between gas density and composition (and hence heating value) of gas made from a given quality of coal.

The application of somewhat similar methods to boiler furnaces is also recommended. The quantities to be measured are either (1) flue-gas composition and draft velocity, the latter measured by differential pressure across the tubes, or (2) draft velocity and steam velocity, both being measured by differential manometers, or (3) total draft and draft velocity, the comparison of which will indicate the condition of the fire.

The book is well written and well printed. It contains more formulas than would be expected in a guide-book for fire-room control, but the author's method does not lack justification.

## Trade Lectures on British Municipal Engineering.

BRITISH PROGRESS IN MUNICIPAL ENGINEERING.—A Series of Three Lectures by William H. Maxwell, Assoc. M. Inst. C. E., Borough and Water-Works Engineer, Tunbridge Wells Corporation; Author of "Refuse Destructors," "Construction of Roads and Streets," etc. (1) General—Road Engineering and Maintenance. (2) Main Drainage, Sewage Disposal, Destructors. (3) Water Supply—Conclusion. Being Volume I. of National Engineering and Trade Lectures, Edited by Ben. H. Morgan. London: Archibald Constable & Co., Ltd. Boards, with Paper Labels; 7 × 10½ ins.; pp. 182; 214 illustrations on folding and full page plates. 6 shillings, net; American price, $2.40.

The unique plan of the series of lectures of which this is the initial volume is nowhere stated in the text, but from the advertising pages we learn:

> The primary object of this scheme of Lectures is to show Colonial and foreign buyers what progress Great Britain has made up to the present time in the manufacture of all classes of machinery and goods. Each Lecture will emphasize novel points of design and utility, and up-to-date British methods of manufacture, and these points will be graphically illustrated in each Lecture, when delivered, by means of lantern slide views, and in the printed copies by means of reproductions of photographs and drawings.

It is further announced that the "first British Industry to be dealt with is that of Engineering," to embrace lectures on 14 topics, including various phases of electrical work, shipbuilding, mechanical road traction, locomotive practice, machine tools, boilers, steam engines, pumps and other subjects.

Mr. Maxwell's three lectures, without the light thrown upon them by the foregoing remarks, might be criticized as decidedly "tradey," page after page consisting of brief descriptive comments on apparatus or supplies of various manufacturers, accompanied by line drawings, half-tones and many cuts taken directly from trade catalogues. All these features, except the poor quality of some of the illustrations, are of considerable value to those unfamiliar with British practice. The summary descriptions of various municipal works and the general comments on the topics treated, added to the trade matter, combine to make interesting and instructive reviews of road construction and maintenance, sewage treatment, refuse destructors, and water supply practice in Great Britain. Water purification is very lightly treated, and practically all said on that subject relates to mechanical filters.

Appended to each section are long classified lists of manufacturers, with addresses. At the conclusion of the whole text there is a bibliography, in which a number of American books appear. Of the mechanical features of the book, paper, typography, presswork and binding are very satisfactory, unless it be objected that the binding will soil easily; some of the line drawings and half-tones are good and some only fair, but many of the cuts from trade catalogues are very poor and sadly disfigure an otherwise handsome volume.

## A New Book on the Steam Engine.

Reviewed by George I. Rockwood,* M. Am. Soc. M. E.

THE STEAM ENGINE AND OTHER STEAM MOTORS.—A Text-Book for Engineering Colleges and a Treatise for Engineers. In Two Volumes. Vol. I.: The Thermodynamics and the Mechanics of the Engine. By Robert C. H. Heck, M. E., Assistant Professor of Mechanical Engineering, Lehigh University. New York: D. Van Nostrand Co. Cloth; 6½ × 9¼ ins.; pp. 391; 190 figures and many tables in the text. $3.50 net.

We are aware that the science of thermodynamics is thought by many—possibly by all—professors of steam engineering in technical institutes to embody the theory of the actual steam engine, and they hold that its study is a necessary preliminary to understanding steam-engine problems. It is hard to see upon what grounds this view can be defended. James Watt knew nothing about the science as taught to-day; neither did Geo. H. Corliss, nor Edwin Reynolds. The history of the past twenty years, during which all the knowledge of "entropy" we may ever expect to have has widely prevailed, yields no single structural improvement, either in the mechanism of the engine or in that of the steam plant, to which we can point as the result of a knowledge of this science. While it has a certain teaching value as an aid in forming correct notions about the expansive working of gases in compressors, refrigerating processes and air engines, we hold that in any case the practical uses of more than a very small part of thermodynamics are strictly limited to furthering mental discipline in engineering students.

Prof. Heck's book deals with steam-engineering problems in the professorial way. Its preparation obviously represents infinite pains, and, judged by the standard of its success in conjuring up academic solutions of the aforesaid problems, it may be conceded at once to be beyond competition as the most fearful and wonderful example of mathematico-diagramatical explanation ever offered to an undergraduate. We commend it to those practical engineers who delight, when off duty, to study cabalistic jargon of this sort; they will doubtless find all they need of it here. For our part, we fear that the ideal up-to-date volume on the steam power plant still remains unwritten, despite the intentions of the author, which are expressed in the preface as follows:

> The objects of this book are, to set forth clearly the fundamental principles of the steam engine, to give a broad description of constructive practice, to explain fully the working of the machine in its several departments, and to show how to find its efficiency in performance. Manner of presentation and order in development of the subject have been strongly influenced by the fact that it is intended to be a text-book for the use of students; but with this has gone the purpose of making it a complete engineering treatise, in which the theory of the steam machine shall be put into a shape convenient of practical application. . . ."

So far as we can judge, the book does not conform to these specifications. Whether the reason lies most in the blindness of the language and phrases, combined with the singularity of the punctuation, or in the mere weakness of the book on the side of practical description, it is difficult to say; but it is hardly true that the principles of the steam engine—"fundamental" or otherwise—are intelligibly set forth. Just what is meant by "a broad description of constructive practice" we do not know. In the present volume there is almost no description of practical things of any sort. Amid the confusion of diagrams and formulae we notice some trade-catalogue cuts of the Ames high-speed engine and of the Crosby indicator—old style. The preface states that the author is about to publish a supplementary volume which is intended to deal more "broadly" with this "department." The present volume is said to be "descriptive and analytical," while the subsequent volume is to be "quantitative and synthetical." Final judgment should, perhaps, be suspended until Vol. II. appears.

As it would hardly be possible to secure the favor of a publisher for a new treatise on this well-worn theme, if entirely destitute of novelties, it goes without saying that Prof. Heck's book contains "certain original features," and the preface states that they are three in number: (1) A formula for cylinder condensation; (2) curves and tables for the steam jet; (3) the full development of the radial analysis for shaking force.

The mere presence of these mathematical novelties in a text-book on the steam engine designed for the use of undergraduates, shows, to our way of thinking, a misconception of the legitimate uses and purposes of such a book; for it shows the author is attempting to train up "raw scientists," as Mr. Swinburne terms them, rather than business engineers. Life is too short to make good engineers out of scientists; however, even granted that these mathematical novelties are a necessary part of a steam engineer's training, would it not have been more reasonable if they, like all new inventions, had been first "tried on the dog?" i. e., first published and discussed in the transactions of some technical or scientific society, and there thoroughly threshed out before being embodied in the permanent form of a treatise whose aim is to be authoritative? If this had been done we fancy the first novelty would have been omitted from the book altogether, because of the sheer uselessness of any possible formula for cylinder condensation, even if an accurate formula were among the possibilities, which it is not.

The chapter on "Dynamics of Steam"—by which is meant simply the steam jet—is certainly unique as an example of the extremes to which the use of mathematical theory may lead one. Here the author evidently feels most deeply that thermodynamic theory provides practical answers to practical questions. The gentle reader may take a different view. However scientifically accurate and in accordance with his premises his tables, formulae, diagrams and ratiocination may be, all these things are practically useless because, on the one hand, his theory assumes—what can't be proved—that no work is lost in overcoming friction or through secondary action in the jet, and that nozzle expansion is essentially adiabatic; and because, on the other hand, it is quite easy to arrive at the most perfect practical designs possible without using a shred of thermodynamic analysis—that is, by the cut-and-try method. And this is the method that must finally be used, whether thermodynamics be first employed or not. Our quarrel here is not with thermodynamics considered as a weighty, scientific and hopeful tool when employed by a scientist for scientific ends; but as a sine qua non forced upon students of practical mechanics as a practical test of steam-engine problems. Too many artificial assumptions must be made before mathematical treatment becomes available; and this, in general, is the trouble with all methods of inquiry into the behavior of steam when worked expansively, excepting only the method of shrewd guessing.

As has been hinted above, the style of the author is frequently irritating because of the lack of suitable connecting words and phrases, because of an unfortunate choice of words and phrases to express his meaning, because of peculiarities of punctuation, and because of the deadly dullness caused by the combination of these characteristics with the presence on almost every page of difficult formulae, tables without self-contained explanations of their purport, and the absence of leaded type at the heads of paragraphs dealing with new subject matter.

It is extremely desirable, in any work on the steam or gas engine, to combine in an early chapter definitions and clear explanations of fundamental ideas, such as "Work." "Energy," "Power," "Force," "Heat," "Temperature." "Friction," "Efficiency," etc. This the author has not done. To keep students awake and interested in their studies it is also desirable to combine the illustrated practical applications of a scientific idea on the same page with the mathematics of it, instead of putting them over into a separate volume as the author proposes to do. For the same rea-

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son that a technical school should carry on simultaneously the study of theory along with daily practice—namely, that the student may not become stale—so, for his inspiration, every page of theory should be accompanied by illustrations showing its practical application. Besides, the method of this book presupposes the possession on the part of its author of the most perfectly trained powers of verbal description, in such snappy, pertinent language as shall make the truth of a matter appear at once.

We may point out that the purely mathematical form of analysis and study is by no means so successful and necessary in studying, for example, the behavior of steam worked expansively as it is in acquiring a knowledge of electricity. This is because electrical rules are of invariable application; every solitary electrical fact and condition is susceptible of exact statement and precise measurement. General experience and judgment laboriously achieved must continue to be the only practical guides in designing actual steam machinery, and it is but folly to fill the heads of students with any other opinion. In saying this we, of course, do not refer to the kinematics nor to questions of stress and strain of the mechanism, but only to considerations affecting the expansion of steam in the cylinder.

In conclusion we must say that the price of this volume—$3.50—seems too high by at least a dollar. W. Ripper's "Steam Engine Theory and Practice," a book of about the same number of words, but with many more illustrations, is sold for $2.50, and is far more applicable to students' needs—as is also Ewing's "The Steam Engine and Other Heat Engines."

A real service would be done English readers if someone would translate the masterly French treatise on the steam engine by Prof. E. Sauvage.

## British Sanitary Law and Practice.

SANITARY LAW AND PRACTICE.—A Handbook for Students. By W. Robertson, M. D. (Glas.), D. P. H., Medical Officer of Health, Leith; and Charles Porter, M. D., B. Sc., Lecturer on Bacteriology, University College, Sheffield; Deputy and Assistant Medical Officer of Health, City of Sheffield. London: The Sanitary Publishing Co., Ltd. Cloth; 6 × 9 ins.; pp. xxiii. + 756; 81 figures in the text. 10½ shillings; postage 4d. American price, $4.20.

A careful examination of this book aids one in understanding how the general death rates and the prevalence of communicable diseases have been lessened in Great Britain during the last fifty years: not that the book is historical in character, but because it sets forth in detail the large volume of "Sanitary Law and Practice" of the United Kingdom, and in so doing shows the admirable legislative and executive machinery in force not only for the prevention of communicable disease, but also for the promotion of health.

The plan of the book is to give first a summary of sanitary and allied legislation for (1) England and Wales, (2) Scotland, and (3) Ireland, and then to review the powers, duties and actual work of medical officers of health, sanitary inspectors, inspectors of nuisances and like officials under the legislative acts.

The central administrative authority for each of the three countries composing the United Kingdom is the Local Government Board. There are no local boards of health, as in America, but instead the general governing body of each city, borough, urban or rural district or parish is constituted a Sanitary Authority. Some of the minor authorities are more or less subject to control by county councils, and over all the Local Government Board is supreme.

The book opens with a few pages on these various authorities, and continues with statements regarding the appointment and qualifications of health officials and sanitary authorities. There then follow sections of Acts relating to general nuisances, smoke nuisances, offensive trades, scavenging and cleansing, pig stys, slaughter houses, unsound food, food and drugs, dairies, cowsheds and milkshops, infectious diseases, prevention of epidemic diseases, isolation hospitals, disposal of the dead (burial and cremation), water supply, sewers, drains, water and earth closets and privies, sewage purification, lodging houses, cellar dwellings, new streets and buildings, housing (of the so-called working classes), diseases of animals, factory and workshop acts, vaccination acts, rivers pollution prevention and still other acts.

The information on practice following each review of legislation is a series of models of concise summaries, and is as full as could be expected in a book of this character.

The book might be of much use in this country, giving, as it does, so much information on health protective work as developed through a half century of slow but steady improvement.

## Steam Engine Valve Gears.

Reviewed by Storm Bull.*

DIE STEUERUNGEN DER DAMPFMASCHINEN.—(The Valve Gears of Steam Engines.) By Carl Leist, Professor in the Royal Polytechnic College, at Berlin. Second Revised and Much Enlarged Edition and the Fifth Edition of the Work of the Same Name by Emil Blaha. Berlin: Julius Springer. Cloth; 6 × 9 ins.; pp. xviii + 940; 553 figures in the text. 20 marks; in the United States, $8.

Although the title page of this book states that it is the fifth edition of a work of the same name by Emil Blaha, yet it is a fact that the two books have nothing in common except the name. This second edition of the work of Carl Leist is also to a great extent a new book. It has been almost entirely rewritten, and a great many additions have been made to it in order to keep pace with the rapid progress of the last few years in this direction. It is a large work, and it would be quite difficult, or perhaps impossible, to hit upon a type of valve gear which is not both described and thoroughly discussed in this work. Like most German books, it is methodical in its presentation of the subject and it is thorough. Unlike a great many German books, it is clearly written, and the author seems to have found a happy medium between trying to explain too much and leaving too much to be worked out by the readers of the book. Although everybody will admit that the valve gear is a very important part of a steam engine, yet one can not help wonder that it should be found necessary to write a book containing 940 pages on this subject, and, in view of what has been stated before, the only justification for such a length, in the opinion of the reviewer, is the thoroughness and comprehensiveness with which the work has been done. There is no book in any language on this subject, so far as the reviewer is aware, which can be compared with it on the basis of thoroughness or comprehensiveness, and it is certain that it contains a good deal of information which either would be difficult to find in the technical literature, or which could be gotten only from the manufacturers of the special valve gears themselves. This fact alone makes the book valuable both to the student and the designer; and when it is added that the very large number of illustrations contained in the book are all drawn to scale, there being absolutely no "pictures," it is hardly necessary to state that its value is still more increased. These illustrations are exceptionally good and represent an amount of work on the part of the author, or of his assistants, an equal of which it would be difficult to find in the technical literature of today. That a translation into the English language would be desirable it is hardly necessary to state; but in view of the size of the book, and the large number of illustrations, both of which would make the book very expensive, it is perhaps entirely useless to express the hope that somebody will be found who is willing to do the work and that some publisher will see his way clear to put it into print. It is evident that a book of this character cannot be as useful to the American engineer as to a German engineer. Necessarily the book describes and discusses a proportionally very much larger number of German valve gears than American ones, and the reviewer is of the opinion that the book would have been decidedly improved if more of the valve gears of American engines had found their place in it, and this without reference to the American readers of the book. However, it is probable that this fault cannot altogether be laid at the door of the author, as it is a well known fact that American manufacturers are apt to refuse any request for detailed drawings of the machine made by them even for the purpose of a book of this kind, and it is apparent that the author has not discussed any valve gears of which he could not furnish illustrations drawn to scale. Be this as it may, the book contains illustrations of the valve gears of quite a number of American engines, and of our best types, but to an American engineer it would seem that the typical high speed automatic engine has not found adequate consideration. It is perfectly true that for large power plants this type is now altogether out of date; but in view of the fact that a large number of this kind of engines is still being made, and,

*Professor of Mechanical Engineering, University of Wisconsin.

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EXTRACTS FROM LETTERS TO AUTHOR OR PUBLISHERS

I consider it an invaluable compendium of technical information for the profession.—A. D. F. Hamlin, Prof. of Architecture, Columbia University.

I note with pleasure the extensive additions of matter of vital present-day interest to architectural practitioners, and I am sure the work will continue to be the standard one of its kind.—Frederick W. Mann, Prof. Architecture, Washington University.

The thoroughness with which it has been rewritten and brought to date call for much appreciation.—R. Harold Shreve, Instructor in Architecture, Cornell University.

The new edition has been greatly extended in many parts, especially in those relating to the steel construction employed in fire-proof buildings. It is now an indispensable reference manual for architects and engineers.—N. Clifford Ricker, F. A. I. A., Dean of the College of Engineering, University of Illinois.

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the reviewer believes, will be made for a long time to come to meet the demands from the practising engineers, a much fuller treatment of the shifting eccentric with its valve gears would have been proper in this book.

Because of the comprehensiveness of this work it is entirely out of the question even to summarize its contents in a review. All that can be done is to call attention to special features which call for comment. As such, the reviewer would point out the truly exhaustive treatment of the subject of the various poppet valve gears now being made, especially in continental Europe. There is no question that they have achieved very remarkable results in the economy of the steam engine, and, in view of the fact that for highly superheated steam the poppet valve is the only one which can be used, it is evident that our American designers can learn a great deal from the study of a book which contains the latest information as to European continental practice in this direction. It ought, perhaps, to be mentioned that the book has a chapter with reference to the special requirements of the valve gear when superheated steam is used.

As a feature of this book the reviewer also desires to point out the fact that the treatment of the subject is graphical from the beginning to the end. Only elementary lower mathematics are required for the understanding of the book, so that any one possessing only a high-school education ought to be able to follow the author. In this respect the book contains a good deal of original material, for instance, the author's graphical proof with respect to the correct curvature of the link of the various link motions. Altogether this graphical treatment is, in the opinion of the reviewer, decidedly superior to the partly analytical one introduced by Prof. Zeuner of Dresden, which has been so extensively used and copied in this country.

In this connection it ought perhaps to be pointed out that the author principally uses the Reuleaux-Mueller diagram for the representation of the valve motion, and only incidentally Zeuner's valve diagram, and then only when both diagrams are shown. In this country, where Zeuner's diagram has become so largely used, this fact might perhaps hurt the usefulness of the book, but it ought to be remembered that it is easy to thoroughly master the Reuleaux-Mueller diagram.

Comparing this book with similar ones in the English language, it will at once be apparent that there is a radical difference with regard to the treatment of the subject. In this work of Leist a very large part treats of the proper design and proportions of the various parts of the valve gear, including the various kinds of valves, whereas the books in the English language hardly go beyond the kinematic problem presented. It needs hardly to be pointed out that because of this difference the usefulness of Leist's book is far greater than the others.

The book deserves to find a large number of readers in the United States, as it is certain that we can learn a great deal from it.

PLANE AND SPHERICAL TRIGONOMETRY.—By P. A. Lambert, Assistant Professor of Mathematics, Lehigh University, and H. A. Foering, Head Master of Bethlehem Preparatory School. New York: The Macmillan Co. Cloth; 5¼ × 7½ ins.; pp. 104.

As a learner's text in trigonometry, this little book is marked by its brevity and simplicity. It gives every impression of being well suited to self instruction—a very valuable characteristic of a scientific or technical work. The treatment is restricted to what is ordinarily meant by the term trigonometry, including the explanation of functions and their relations, and the equations of triangles, giving the determination of unknown sides and angles. Close adherence to this restriction is felt in the part on Spherical Trigonometry, but even here all is given that will be required in the majority of cases. A goodly number of practical problems is appended to the various sections.

## Correction.

Our attention has been called to an error in "A Home-Study Course for Machinists and Others," by Mr. Ernest McCullough, abstracted in this Supplement for March 16. Professor Parson's "Steam Boilers" is published by Longmans, Green & Co., instead of by John Wiley & Sons, as stated in the article.

## A Text-Book on the Displacement, Velocity and Acceleration of Machine Parts.

Reviewed by G. R. Henderson,* M. Am. Soc. M. E.

MECHANISM.—By S. Dunkerley, M. Sc., Assoc. M. Inst. C. E., M. Inst., M. E., Professor of Applied Mechanics in the Royal Naval College, Greenwich. London, New York and Bombay: Longmans, Green & Co. Cloth; 5½ × 8¾ ins.; pp. 408; 416 figures in the text. $3.

In the preface of this work, Professor Dunkerly tells us that the book is intended for use in the university and technical colleges, and is not meant to be a philosophical treatise on the subject, and in the introductory chapter he states that it deals only with the kinematics of machines, and is not intended to cover the design of machine parts, or the study of the dynamics of machinery: that is, only the displacement, velocity and acceleration of the parts of machines will be considered, and that questions of strength and force will not be discussed. This briefly describes the intent of the work and defines its limitations.

The second chapter, treating of simple machines and machine tools, deals with such elementary problems as belt and tooth-gear transmission, wedges and screws, but in addition gives some very interesting and modern examples of steam steering gears for steamships, automatic screw-cutting machinery and bicycle cyclometers.

The following chapter deals principally with parallel motions, but as *guides* are so largely used nowadays, this has little interest to the engineer, except for some forms of engine indicators and indicator riggings. The steering mechanism of automobiles is touched under this heading, as well as elliptical chucks and copying mechanisms, the latter including the description of some modern tools.

Chapter IV. discusses instantaneous centers of rotation, and illustrates the subject by numerous diagrams of the direct-acting engine, with connecting rod and crosshead. The breech mechanism of guns, the operation of pneumatic riveters and the line proportions of various quick-return motions are considered and described. A very interesting and clear discussion of the velocity variations in universal joints and their application to machines of different kinds is also given.

In chapter V. the "vector" method of studying relative velocities is taken up, and geometric analyses of various valve motions, such as those of Stephenson, Marshall and Joy, are given. These methods are much more complicated than those of Zeuner, particularly when the valve displacement alone is wanted, as is usually the case, and we doubt if they would be nearly as useful as the latter.

The chapter on acceleration diagrams is the most interesting in the book. It contains a very elaborate discussion of the crosshead or piston acceleration of a direct-acting engine. Klein's construction is very fully treated, particularly as regards the point of maximum piston velocity or zero acceleration and the corresponding crank angle. This seems to us the best description which we have seen of this important mechanism.

The last two chapters treat of toothed gearing and cams, but contain little that is new, unless it be a description of Renolds chain gearing. On page 301 it is stated that the least number of involute teeth in a wheel is usually 24, to which we must take exception, as is patent to most everyone. Also in describing machines for cutting gear teeth, some of which are very complicated, the well-known method adopted by Brown & Sharpe, and universally used in this country, is simply thrown aside with the statement that the teeth cut by means of a rotating and milling tool are not theoretically accurate, and will not be discussed. We think this is rather a slighting way in which to dispose of the very useful Brown & Sharpe cutters.

The book is very pleasing in appearance: the type is clear and the illustrations are good, but some typographical errors have crept in, as the use of *eclipse* for *ellipse*, and the acceleration of *piston* instead of *crank*, on page 259. Taking it altogether, however, it is an interesting addition to a branch of study that has been quite largely written up heretofore.

*Consulting Engineer, 20 W. 34th St., New York City.

## Publications of the International Engineering Congress.

A circular has been issued by Mr. Chas. Warren Hunt, Secy. Am. Soc. C. E., 220 W. 57th St., New York City, calling attention to the fact that the Publications of the International Engineering Congress, held at St. Louis, in 1904, will consist of six volumes, covering more than 3,000 pages, containing some 600 illustrations, and including 97 papers, with discussion, on 37 subjects. To persons and institutions not now enrolled as members of the Congress, the price of the publications has been fixed at $5 per paper covered volume, less 10% "to all who receive this circular." Two volumes are now in press. The edition will be limited. Inquiries should be addressed to Mr. Hunt, as above.


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## The Esthetic Improvement of Cities.

MODERN CIVIC ART.—Or the City Made Beautiful. By Charles Mulford Robinson, Author "The Improvement of Towns and Cities." Second Edition, with Illustrations. New York and London: G. P. Putnam's Sons. Cloth; 7 × 10 ins.; pp. 381; 30 plates. $3.00, net; by mail, $3.20.

In the hearty welcome given the first edition of this book (Supplement for July 16, 1903), we called attention to the increased usefulness that might be ensured by adding illustrations. The thirty well chosen and well executed illustrations which appear in the present edition greatly increase both the utility and attractiveness of the book, while the more ample margins are a still further artistic gain. The aim of the book is well expressed by the sub-title, "The City Made Beautiful."

Most of the illustrations are in the form of half tones of unusual merit, including street and water scenes, civic centers, railway stations, public fountains and statues and scenes in parks. Of the three diagrams, one is "Sir Christopher Wren's Plan for Rebuilding London After the Great Fire in 1666," with its civic centers and radiating streets, and the other two are charts of the public reservations in the Boston and the London metropolitan districts. Still other charts might have been inserted to advantage, but the illustrations as a whole are well worth the half dollar added to the price of the first edition. We now feel more than ever like saying, as we did nearly two years ago, "Undoubtedly the book will have a marked effect upon modern civic art, and one which will not be confined to this country." We wish the book could somehow be put in the hands of every city engineer and street and highway committee, as well as architects generally. Civic societies, art societies and all other organizations devoted to municipal improvements might well bring the book to the attention of their members and of the public.

DIE BERECHNUNG VON VERBUND-DECKEN IM BAU-GEWERBE.—By Professor G. Barkhausen, Hannover, Germany. Reprint from the "Deutsche Bauzeitung." The Author. Paper; 5¼ × 8¼ ins.; pp. 22; 9 diagrams in the text.

The author presents a very compact and staightforward development of formulas for designing and analyzing reinforced concrete structures. Simple floor plates, combined arch and beam plates, simple beams, and ribbed plates, are discussed, formulas being derived for each case in two forms: (1) For designing; (2) For analyzing. The general beam assumptions of special interest are: (1) Tensile value of concrete is neglected (in accordance with the Prussian Public Works regulations, but contrary to the author's convictions); (2) The modulus of elasticity of concrete is assumed constant, i. e., its stress strain curve is assumed to be a straight line; (3) Plane sections remain plane. In the subject of ribbed plates, the author proceeds on the principle that the neutral axis of the ribbed structure should, for economy, lie in the bottom surface of the floor-plate. However, to care for the negative moment in the plate over the supports, the plate is bracketed downward adjacent to the ribs, by a calculated amount.

A special feature of the author's treatment is the derivation of formulas for the stress tending to pull the bars out of the concrete, and formulas for transverse shear and longitudinal (bottom) shear in the concrete. The shear treatment is extended to the point of giving a formula for the length of straight portion of a reinforcing bar, and formulas for the required metal section in the oblique portions of the bars.

COPPER AS AN ALGICIDE AND DISINFECTANT IN WATER SUPPLIES.—By George T. Moore, Physiologist and Algologist in Charge of the Laboratory of Plant Physiology, and Karl F. Kellerman, Assistant in Physiology. Bulletin No. 76. Bureau of Plant Industry, U. S. Department of Agriculture. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 55.

Accounts, generally brief, of the use of copper sulphate as an algicide in 28 reservoirs and for the sterilization of water at Columbus, O., Albuquerque, N. M., and Anderson, Ind., are here given. At Anderson the copper sulphate was used with iron sulphate in mechanical filters. The authors believe that the efficiency and practicability of copper sulphate as an algicide and as a germicide is well established, but do not advocate its use as a germicide except in cases of emergency. They believe, and cite authorities in confirmation, that copper as used in water is not harmful to the human system, and suggest its possible usefulness in treating typhoid fever patients. Since the publication of Bulletin 64 (largely reprinted in Engineering News of May 26, 1904), it has been found that "the concentration" of copper sulphate "necessary to kill algae in the laboratory is from 5 to 20 times as great as that necessary to destroy the same species in its natural habitat." It has also been found that the effect of the agent on fish is more marked than was at first supposed. A few pages of the pamphlet are devoted to means for determining the exact character of the algae which is giving trouble.

## A Descriptive Text on Some Branches of Civil Engineering.

LEHRBUCH DES TIEFBAUES.—By T. Landsberg, H. Wegele and L. v. Willmann, Professors at the Darmstadt Technical College. Professor Karl Esselborn, Darmstadt, Editor. Leipzig: Wilhelm Engelmann. Paper; 7 × 11 ins.; pp. 782; 1,471 illustrations in the text. 20 marks; American price, $8.

A peculiar range of subjects is in this work embraced under the rather indefinite German term "Tiefbau." The contents range from Foundation work and general earth construction, which are the core of "Tiefbau" or Subsurface Work, as far as bridges, railways, and canal construction. The scope of the book was determined by the prevailing courses in the Prussian technical colleges, for which it is intended as a text-book. Aside from this purpose, however, there is no apparent logic in the selection and grouping of subjects. The various subjects belong to a number of different branches of the civil engineer's art, and on one branch is covered in its full extent, even with regard to the purely descriptive treatment to which the book is restricted.

Thorough treatment of any one of the half-dozen subjects considered would require as much space (or more) as the entire volume affords. It will be evident, therefore, that the discussion of each subject can only be a condensed descriptive outline of purposes and methods of work. Abundance of illustration, chiefly by well-executed drawings and diagrams, has been relied upon to make the description more forcible. The reference to more detailed works, which in such a text is very important, seems to be mainly to the "Handbuch der Ingenieurwissenschaften," a restriction which is, to say the least, unfortunate, in spite of the excellence of that work.

The book opens with a chapter on the elementary methods of earthwork, omitting all reference to more specialized methods such as apply to larger work. Even in the elementary methods it is surprising that the drag and wheel scrapers did not find mention alongside shovel and barrow, wagon, and dump cart. Steam shovels and the like are, of course, outside the scope of this book. A following chapter on foundations also is very general. Chapter III., on Street and Roads, is more thorough than any other part of the book; it covers general shaping, details, pavements, layout of roads and of city streets, cleaning and sprinkling, etc. Under roads macadam is mentioned, and Telford's name is omitted, the style of stone road named after the latter in England and America being here credited Trésaguet (1775). On this subject we may profitably insert a quotation from Tillson's "Street Pavements and Paving Materials" (New York, 1903):

> While probably small broken stone was used in roads for many years previous, it was not until 1764 that what is known at the present time as macadam roads were first built systematically by M. Trésaguet, a French engineer, who was the first to adopt this plan, and it came into general use about ten years later.
>
> . . . . . .
>
> This method as just described was practically that adopted by Telford some forty years later in England, the difference being principally in making the subgrade level and forming the crown with the stone itself, rather than making the base parallel to the finished surface of the road as Trésaguet did.

Railways, Chapter IV., are considered in the full range from location surveys to station-buildings; track details, maintenance, etc., are more fully described than other parts of the subject. Chapter V. describes bridges, stone, wood and metal, including a mention of reinforced-concrete under stone; nothing is said of analysis, except that formulas are given for arches, but types of bridges, general arrangement of parts, and details, are well covered. The last chapter, on Hydraulic Construction, is quite varied in contents. It deals with hydrological measurements, weirs and dams, the collection and distribution of water for water-supply, describes some forms of wells, infiltration galleries, and tanks, then passes to sewerage, showing forms and construction of sewers, manholes and inlets, and finally describes the main features of canalization, river protection and regulation work, and levees, locks and canals.


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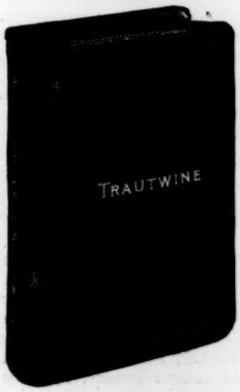


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## A Text-Book on Influence Lines and their Application to Bridges.

Reviewed by Leon S. Moissieff, Assoc. Mem. Am. Soc. C. E.*

THE GRAPHIC METHODS BY INFLUENCE LINES FOR BRIDGE AND ROOF COMPUTATIONS.—By William H. Burr, M. Am. Soc. C. E., M. Inst. C. E., Professor of Civil Engineering in Columbia University; and Myron S. Falk, Ph.D., Jun. M. Am. Soc. C. E., Instructor in Civil Engineering in Columbia University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6 x 9 ins.; pp. 253; 158 figures in the text, and three folding plates. $3.

Some thirty years have passed since the geometrical representation of the effect of a load moving along a beam or truss on a section or a member of the latter made its first appearance in engineering literature. During the first ten years following the introduction of influence lines and their application to trusses of various types their theory and characteristics were mainly developed by German engineers and rapidly adopted and extended by their engineering brethren on the European continent. The writer believes that the first introduction of the subject into American engineering literature was effected by a very good paper "On the Calculation of the Stresses in Bridges for the Actual Concentrated Loads," presented by Prof. George F. Swain before the American Society of Civil Engineers in 1887. Since then several able writers have treated and discussed the subject, mainly in the Transactions of the American Society of Civil Engineers, extending and simplifying the application of influence lines to the determination of the greatest stresses in trusses subjected to a series of concentrated loads. More recently some of the more prominent bridge companies have come to make use of influence lines in their computation of stresses; they have also found use in some engineering offices. As the most notable application of influence lines in this country may be mentioned, because of the great cost and importance of the structures, the check computations for the eye-bar cable design for the Manhattan Bridge and for the Blackwell's Island cantilever bridge at New York City, the latter of which is at present in the process of erection.

But the use of influence lines among engineers was not as widely spread as it might have been because of the lack of a treatise on the subject giving a simple and clear treatment so as to enable every engineering student to become well acquainted with the character and application of the method. It is characteristic of the application of graphical methods in engineering offices that not only must the engineer in charge of the computations be thoroughly conversant with them, but also all of his assistants so that he may turn over the mechanical work to them without difficulty. As long as a universal and readily accessible knowledge of influence lines is not prevalent their use for computations must needs be limited to such offices as have enough of this work to make it worth the while to train their men to it. Only recently influence lines began to be considered in text-books. The book by Messrs Burr and Falk is well adapted to supply the want of general and elementary information on influence lines, and will thus be greatly helpful in making their use more general.

While bearing the title of "The Graphic Method by Influence Lines for Bridge and Roof Computations," the book is really intended as a text-book for the use of the Civil Engineering students at Columbia University, and as such it contains an introductory chapter of 59 pages on the "General Principles of Graphic Statics, and Application to Roof Trusses." It gives the necessary definitions and treats of the funicular polygon, which is sometimes known as the equilibrium polygon, and of its characteristics. The use of the Cremona diagram for finding the stresses in roof trusses is fully explained and illustrated by numerical examples for several varieties of roofs. To this is added an article treating in a clear way of the "Bending of Supporting Columns of Roofs," both in the case of columns hinged at their bases and of columns rigidly connected to them. This chapter could, of course, be extended and much valuable information be added to it were its scope not limited.

The subject of influence lines proper and their application to bridges comprises some hundred pages with numerous illustrations, which treat of influence lines for simply supported bridge trusses, three-hinged arches and cantilevers. The influence lines for reactions and shears are explained and the most important instrument in the use of this method, the reaction influence line of Mueller-Breslau, is deduced in a lucid manner. Moment influence lines are then introduced and the well-known criterion for the maximum moment at any section of a beam deduced. The reaction influence line is made use of to determine the greatest stresses in the web and chord members of a truss with parallel and horizontal chords. The simple procedure followed in determining the point of no stress in the web member of any simply supported truss is then given and use of it is made in the first of two methods for drawing the influence line for the stress in any web member of any simple truss. The second method makes use of the fact that the straight lines of any influence line or their prolongations corresponding to each side of the panel in question will always intersect on the vertical through the center of moments for the member whose influence line is drawn. This furnishes a very convenient means of drawing the influence line and is especially fruitful in its application to three-hinged arches. It should be added that the principle stated in the above is established and discussed in a paper by Prof. L. M. Hoskins on the "General Criterion for Position of Loads Causing Maximum Stress in Any Member of a Bridge Truss," presented before the American Society of Civil Engineers in 1899.

An easy method of finding the counter stresses in a vertical post in camel-back trusses is deduced which the reviewer has not met before, and which appears to be simple in application.

Influence lines are well adapted for application to three-hinged arches, and the chapter on this class of bridge-structures is good testimony for the fact. But in no case is the history of a stress in a given member so well told as in the influence lines for cantilevers. The fifteen pages devoted to them in the book give a good idea of their character and the methods of drawing them. Apparently the methods of Mueller-Breslau's "Graphische Statik," which is the most thorough work on the subject, have greatly been followed, but many points have been made clearer in the book reviewed, and the subject has been brought nearer to the engineering student than they are in the German work.

A short chapter is devoted to the Deformation of Trusses. It treats of the Williot diagram, that simple and excellent method for determining the displacements of any points of a truss due to a given set of stresses. It is so elegant in its treatment and so well-known in foreign books that the writer always wondered why until recently it had not made its appearance in American text books.

To the knowledge of the reviewer, Williot published his diagram at about the same time when influence lines were first introduced, in the seventies. It is based on simple geometrical deductions, and is really the brother of the Cremona stress diagram. It should appeal to engineers, and even to those who do not care to be troubled by influence lines.

The last chapter, comprising some 70 pages, gives the detailed design of a railroad bridge according to Cooper's Specifications, following through the complete design from stress to rivet. It is of interest mainly to the beginner in bridge design, and is intended for the students at Columbia University.

In their introduction the authors state that "sufficient problems are introduced to illustrate clearly the practical applications of the various methods of treatment, but it should always be borne in mind that the greatest advantage will accrue to those students who work out original problems and make independent practical applications."

The make up of the book presents clear typographical execution with the many diagrams clearly drawn, but it is to be regretted that no use has been made of color lines, as can be found in Mueller-Breslau or in the recently published work of Mehrtens, "Statik der Baukonstruktionen." A much clearer image is obtained by the aid of color lines. A short bibliography of the subject will be much missed by students and practising engineers when treating special problems. This will probably be remedied in the second volume which is promised by the authors, on "the application of influence lines to statically indeterminate structures, such as two-hinged and fix-end arches, swing bridges, suspension bridges, and certain types of cantilevers."

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THE BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS OF THE COMMONWEALTH OF MASSACHUSETTS.—Twentieth Annual Report. For the calendar year 1904, including tables from the annual returns for the year ending June 30, 1904. Boston, Mass.: Pub. Doc. Paper; 6 x 9¼ ins.; pp. 198 + clxxix.

The usual interesting statistical and other information is given in this volume. The board now has under its supervision 144 companies, of which 26 supply both gas and electricity, 50 supply gas only, and 68 electricity only; also 21 municipalities, of which four supply both gas and electricity and 14 electricity only.

## Paint Mixing.

Reviewed by W. M. Stiles.*

HOW TO MIX PAINTS.—A Simple Treatise Prepared for the Wants of the Practical Painter. By C. Godfrey. New York: Industrial Publication Co. Cloth; 5 x 7½ ins.; pp. 64; six figures in the text. 50 cts.

This book is intended, the author says, to aid those who have not had a long experience to become practical painters, and by this he evidently means house painters, as he scarcely touches upon the art of carriage painting or anything but the simplest kind of decoration.

The fromulas given for making various popular colors, shades or tints can only be regarded as suggestions, because they must necessarily deal with names of pigments—names which can have no definite meaning in respect to strength or purity of tone. Suggestions of this kind are, however, of the greatest help to the painter who wishes to be progressive as they serve to crystalize and bring into definite form things which he already knows in the abstract, induce new lines of thought and new desires for experiment and practice which alone makes perfect in the art of color mixing.

On page 27 one is cautioned never to mix ultramarine with white lead or any pigment containing lead because chemical action will take place, causing the mixture to become a dull, muddy color; only two pages further on, in advising how to make lavender color, one is told to use ultramarine and white lead with carmine and ivory black.

Certain statements laid down by the author as axiomatic are subject to criticism. He says, "White added to any color gives a tint of that color; black added to any color gives a shade of that color." Now black added to chrome yellow, for instance, does not give a shade of yellow, but gives an olive or bronze green. The reviewer believes that the general understanding of shades and tints, as the terms are used by ordinary painters and manufacturers, is that the tints are the lighter, more delicate-toned mixtures, while the shades are the mixtures of a heavier hue, quite as often without black at all as with it.

The advice on the care and keeping of brushes offers many valuable hints and is worthy of the careful notice of the painter, but in this country it would be folly to proceed according to any fixed rule without first observing the caution or notice almost always given with each particular brush by its manufacturer. To "thoroughly soak" in water a glue set paint brush would probably lead to disastrous results.

The book contains a fine explanatory index covering even more than its subject matter. The book can be recommended to the painter as a practical aid in his work and as a whet to his desire for greater proficiency.

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WATER-SUPPLY AND IRRIGATION PAPERS, U. S. GEOLOGICAL SURVEY.—Charles D. Walcott, Director. Washington, D. C. Pub. Doc. Paper; 6 x 9 ins.

No. 109: Hydrography of the Susquehanna River Drainage Basin. By John C. Hoyt and Robert H. Anderson. Pp. 210; 29 plates and nine text illustrations.

No. 111: Preliminary Report on the Underground Waters of Washington. By Henry Landes. Pp. 85; one plate.

No. 113: The Disposal of Strawboard and Oil-Well Wastes. By Robert Lemuel Sackett and Isaiah Bowman. Pp. 52; four plates and four text illustrations.

No. 121: Preliminary Report on the Pollution of Lake Champlain. By Marshall Ora Leighton. Pp. 119; 13 plates and nine text illustrations.

Papers 109 and 111 need no comment further than to say that No. 109 seems to be an unusually extended hydrographic study of a river basin.

Mr. Sackett's portion of Paper 113 contains a good description of the manufacture of strawboard and of the character of the wastes. It also gives an account of experiments on the disposal of the wastes, including sedimentation, filtration and chemical precipitation. It was concluded that carbon dioxide and milk of lime afford an effective and practicable agent for precipitating the wastes, and that where a high efficiency is required precipitation can be supplemented by sand filtration. Mr. Bowman's studies of the "Disposal of Oil-Well Wastes at Marion, Ind.," led him to conclude that for protection of the water supply of the section it is imperative that the wastes be conveyed away in conduits.

*Superintendent Edward Smith & Co., New York City.

Paper 121, by Mr. Leighton, embodies a preliminary account of a study of the pollution of Lake Champlain by pulp-mill wastes from the New York side of the lake and by sewage, the latter chiefly from Burlington, Vt. The soda and sulphite pulp processes of manufacture, the character of the resulting wastes, and the effect of the latter upon rivers on which the mills are located and on the waters of Lake Champlain are described in detail, with the aid of numerous water analyses. Analytical studies of the effect of sewage on the lake water are also presented. In summarizing his studies on page 115, Mr. Leighton is somewhat non-committal and indefinite both as the extent and the harmfulness of the pollution from the pulp mills, but from this summary and from the text he appears to regard the pollution as less serious than did the State health authorities of New York after their investigation of the same subject. As to the dangerous sewage pollution near Burlington at the present time and the serious menace of sewage from this and other communities in the future Mr. Leighton writes emphatically in the affirmative.

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REPORT OF A SPORADIC OUTBREAK OF TYPHOID FEVER AT LAWRENCE, N. Y., DUE TO OYSTERS.—By George A. Soper, Ph. D., of New York. Reprinted from "The Medical News," Feb. 11, 1905. Address: The Author, 29 Broadway, New York. Paper; 6 x 8 ins.; pp. 38; seven illustrations.

The dangerous character of oysters taken from or fattened in waters subject to sewage pollution is gradually being recognized, but much educative work will be necessary before the full extent of the danger will be appreciated. Such reports as the one now before us are serving a useful purpose. The number of cases of typhoid here investigated was relatively small, only 31, but as comparatively few of the oysters in question were consumed in the communities studied, it is probable, as Mr. Soper suggests, that a hundred cases were caused elsewhere for each one reported in Lawrence and vicinity. The author of the report believes that oyster beds were polluted by the untreated sewage of Arverne, and that oysters on floats were polluted by the effluent from the chemical precipitation works of Far Rockaway, a portion of the Borough of Queens, New York City. Analyses of water and sewage effluent and a review of typhoid cases are given in the report, which was made to the board of health of Lawrence.

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PROCEEDINGS OF THE INCORPORATED ASSOCIATION OF MUNICIPAL AND COUNTY ENGINEERS.—Volume XXX., 1903-1904. Edited by Thomas Cole, Assoc. M. Inst. C. E. (Secretary of the Association). London: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Cloth; 6 x 9 ins.; pp. lx. + 674; many folding plates and drawings.

This volume gives in full the papers and discussions and the business proceedings of the one annual and nine district meetings held during 1903-4 by the Association whose title it bears. There were altogether 28 papers presented at these meetings, and among them we note the titles of the following that are of general interest: "Transporter Bridge Over the Mersey at Widness," by J. J. Webster; "The Aberdeen Electric Cable Subway and High Level Sewer," by G. R. G. Conway; "East Hill Water Balance Passenger Lift at Hastings," by P. H. Palmer; "Ventilation of Sewers," by H. G. Whyatt; "Shone System of Sewer Ventilation," by E. G. Mawbey; and "Isolation Hospitals," by F. Smyth.

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INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.—Proceedings of the Ninth Annual Convention, held at St. Louis, Mo., September 13 and 14, 1904. (Corning, N. Y.: Frank P. Foster, Secretary.) Cloth; 6 x 8¾ ins.; pp. 130.

The following technical papers appear in this volume:

"Street Lighting," by A. S. Hatch; "The Limitations of the Telephone for Fire Alarm Purposes," by A. Bosch; "The Inspection of Theaters from an Electrical Standpoint," by W. H. Thompson; "Methods of Testing," by W. W. Petty.

The last-named paper raised some discussion in electrolysis of underground pipes.

Discussion of several other questions is also included. The following are of technical character: What is the maximum number of fire-alarm boxes considered advisable on one circuit; What is the best protection for terminal heads for underground work; What is the best underground construction for fire and police telegraphs.

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REPORT OF THE ILLINOIS GOOD ROADS COMMISSION.—Springfield, Ill.: The Commission. Paper; 6 x 9 ins.; pp. 56.

This Commission was appointed two years ago, and has now made its first report. It shows that in 1903 there were about 101,000 miles of wagon roads (exclusive of streets in cities, towns and villages), while the tax raised for road and bridge purposes was $3,792,080, besides about $540,000 paid to road officials out of the town funds. A statement prepared by Professor Crantz, State Geologist, shows the distribution of road building material. Roads surfaced with stone and gravel aggregate 3,495 miles, the reported cost of which varies very greatly: from $180 to $4,000 per mile for gravel, and from $40 to $6,000 per mile for stone. The report discusses drainage, convict labor, State aid, and suggests that in Illinois the State should pay 50% and the county and township 25% each of the cost of improved roads. The report occupies 26 pages, and is followed by notes on road legislation in other States, traction tests on different kinds of roads, and extracts from addresses on the subject of good roads.

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The descriptions include 12 works employing contact beds for final treatment; 5 works employing percolating filters for final treatment; 3 sewage farms; 3 chemical precipitation works. The settling and screening plant at Wiesbaden, the settling tanks at Frankfort-on-Main and the sewage farms of Paris are described in Appendix 1, and a second appendix gives brief descriptions of typical processes of sewage treatment.

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## Cement Manufacture.

THE MANUFACTURE OF HYDRAULIC CEMENTS.—By Albert Victor Bleininger, B. Cc., Instructor in Ceramics, Ohio State University. Fourth Series, Bulletin No. 3, Geological Survey of Ohio. Edward Orton, Jr., State Geologist. Columbus, Ohio: Pub. Doc. Cloth; 6½ × 9¼ ins.; pp. 391; 81 figures in the text.

This bulletin is a brilliant exception to the usual State Geological Survey treatise on industrial technology. In most cases such efforts result in rather poor examples of paste-pot-and-scissors bookmaking, but in the present instance this criticism must be completely reversed. Mr. Bleininger has not only produced a useful report on the cement resources of Ohio, but he has also produced a capital little treatise on cement manufacture. In view of this fact, engineers who have long had occasion to bewail the lack of published information may well be gratified at the present excursion of the Ohio Survey outside its legitimate field of investigation. As a technical treatise pure and simple, the bulletin has certain obvious and natural shortcomings, but with all these it is a better treatise on cement manufacture than is to be had anywhere else in the English language at least.

Setting aside the official preamble, the author first classifies and defines the four distinct kinds of hydraulic materials: Pozzuolane cements, hydraulic limes, natural or Roman cements and Portland cements. The constituents of these compounds are then named, and silica and its salts, alumina and ferric oxide, lime, and, finally, magnesia, are described in respect to the forms suitable for cement manufacture in which they occur in nature and in respect to the relative roles which they play in the formation of hydraulic materials. These considerations bring the author to a discussion of the raw materials actually used in the commercial manufacture of cement. Attention is given first to the raw materials for pozzuolane cements; the natural pozzuolanes, such as pozzuolane proper, trass and santorin earth are briefly discussed, and then some ten pages are devoted to artificial pozzuolanes, the most important of which is pig iron blast furnace slag. The proper composition and texture of slags for cement making are described, and this is followed by an interesting section on the formation of slags.

The raw materials for natural cements are briefly described in character and occurrence, and a table of analyses of representative American cement rocks is given. As would be expected, Portland cement raw materials are considered at greater length than any of the others. The clay materials are discussed first, and the author enters in detail into their origin, character and composition, and into the effect of feldspar, mica and quartz constituents of clays. Lime materials are divided into four classes, varying from dense crystalline limestone to chalks and marls. The general discussion of cement materials is followed by an elaborate statement of the lime resources of Ohio available for Portland cement manufacture.

The chapter on raw materials is succeeded by a most interesting and valuable discussion of the chemical and physical examination of cement materials. In this chapter the author gives methods to be employed in prospecting and sampling and in conducting chemical and physical analyses. Some 55 pages are devoted to these matters, and they constitute one of the most useful portions of the book for the average engineer.

Chapter IV. describes the process of manufacture of slag cements and of natural cements. The processes and machinery are simple in both cases, and the score of pages devoted to each material is ample to give a clear idea of them. Chapter V. is a rather elaborate discussion of the nature or constitution of Portland cement as determined by various experiments. The author divides the various experimental researches into mineralogical investigations, the study of synthetic mixtures, the study of hydration reactions, determination of calcium oxide and the study of heat reactions. The results and conclusions of the various workers in each of these lines of study are summarized and are followed by a summary of the contending views. A concluding section outlines the author's own observations to determine just how and at what temperatures the lime combines with the silica during calcination. Chapter VI. discusses the compounding of cement mixtures, and gives several methods and formulas for performing this task in practical manufacture.

In Chapters VII. and VIII. the author describes in detail the process of Portland cement manufacture, considering first the winning and preparation of the raw materials, and next the calcination of the raw mixture and the reduction of the burned clinker. Altogether some 85 pages are devoted to these subjects, and they constitute the best general account of the various machines and mechanical processes employed in manufacturing Portland cement that has yet appeared in print. The final chapter on the properties and testing of cements contains nothing that is not to be found in the standard recent books on cements.


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A WELL-ORDERED HOUSEHOLD; OR, THE IDEAL CITY.—By William Arthur. Containing plans and specifications for a proposed model city. Omaha, Neb.; The Author. Paper; 6x7½ ins.; pp. 69. 10 cts.

The "plan" of this ideal city occupies the back cover of the pamphlet, and the brief "specifications" are scattered through seventeen short and mostly discursive chapters not always related to the main subject. The pamphlet is interesting, and contains good suggestions for those who have the time to read so much for the sake of gaining so little. Mr. Arthur is also the author of "The Building Estimator," reviewed favorably in this supplement for Aug. 18, 1904.

THE ASSUAN RESERVOIR AND LAKE MOERIS.—By Sir William Willcocks, K. C. M. G., M. I. C. E., Managing Director Daira Sanieh Company. A lecture delivered at a meeting of the Khedivial Geographical Society, Cairo, January 16, 1904. With translations in French and Arabic. London: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Cloth; 7 x 12 ins.; pp. 36 + 40 + 39; five folding plates. $2.

The author has long been a close student of Egyptian irrigation problems and was at one time director-general of Egyptian reservoirs. Some four years ago he published a thin book on "The Nile Reservoir Dam at Assuân and After." In the lecture composing this book he outlines a plan for providing perennial irrigation and flood protection for all Egypt at a total cost of about $40,000,000, distributed over 25 years. The plan includes an addition to the height of the Assuân dam, a new Lake Mœris to serve the same purpose (storage and flood protection) as the one in existence 4,000 years ago, river protective works in upper and in lower Egypt, regulation works for Lake Victoria Nyanza and dredging and training the Nile in the Sudd regions (£100,000 a year for 25 years).

THE TORRESDALE CONDUIT.—By John W. Hill, Chief Engineer, Bureau of Filtration, Philadelphia. Read before The Engineers' Club of Philadelphia. Paper; 6 × 9 ins.; pp. 61; 30 illustrations in the text.

The Torresdale conduit or tunnel is to convey filtered Delaware River water to the Lardner's Point pumping station of the Philadelphia waterworks, and is designed for a daily capacity of 300,000,000 gallons. It was described at length in Engineering News of Dec. 1, 1904. In this paper now before us Mr. Hill describes the tunnel in detail and gives some interesting figures regarding leaks into the tunnel and the comparative tightness of other tunnels and conduits; he also describes how the leaks were stopped.

SEWERAGE AND SEWAGE DISPOSAL, YORK.—By Alfred Creer, Assoc. M. Inst. C. E., City Engineer and Surveyor. Paper read at the District Meeting of the Incorporated Association of Municipal and County Engineers, held at York, May 14, 1904. (York, England: the author). Paper; 5½ × 8½ ins.; pp. 32; six diagrams.

Mr. Creer has been experimenting with septic tanks, contact beds and continuous filters since April, 1899. In this paper he reviews the experiments up to March, 1904. These York studies were carried on with large sized units under working conditions, and the paper is both interesting and instructive.

### Tables of Squares, Logarithms, and Angular Functions, Especially Designed for Architectural Calculations.

TABLES FOR ROOF FRAMING, ETC.—Revised and Extended, with Logarithms of 32ds from Zero to 60 Feet. Sines, Tangents, etc., for Draftsmen. By G. D. Inskip. Philadelphia, Pa.: New York: M. C. Clark. Leather; 5¾ × 7¼ ins.; pp. 206; illustrated. $2.50.

The title of this book does not tell all that it contains. While the tables are particularly useful for roof framing, they are equally useful to any engineer or architect having work to do involving measurements in feet, inches and fractions of inches; for there are few classes of work in which the solving of right-angle triangles does not form an important part of the calculations.

The table of squares gives the square of every number up to 60 ft., progressing by sixteenths of an inch; thus, the square of 59 ft. 6 11-16 ins. is, by the table, 3547.071. Up to 2 ft. the squares are given to five places of decimals; up to 6 ft., to four places of decimals; and beyond that, to three places of decimals. This makes it possible to interpolate with accuracy where it is desired to secure the square of a dimension given in thirty-seconds of an inch.

A table of logarithms gives the logarithm of every number up to 60 ft., progressing by thirty-seconds of an inch; thus, log 59 ft. 7 13-32 ins. is 1.77537. There is also a table of logarithms of 64ths up to 1 in., the logarithms being carried to six decimal places. A table of logarithms of whole numbers from 1 to 1,000 is given, carried to seven places of decimals.

A very handy table is one entitled Table of Pitches. It gives three logarithms of pitches per foot run from 1 in. to 18 ins., advancing by 32ds. Given the rise of a rafter in inches and fractions per foot run, and the length of the base, this table enables the computer quickly to ascertain the length of the rafter by the use of logarithms.

Tables of natural sines and cosines for every minute of the quadrant are given; also logarithmic sines, tangents, cosines and cotangents (carried to seven places of decimals).

A table is given of decimal equivalents of inches and fractions, advancing by 32ds and 64ths up to 12 ins.

A book of tables should be clearly printed on the best paper, and bound so that it will stay open at any page when lying on the desk. This book meets these requirements and leaves nothing to be desired.

### Literary Magazines.

The state management of the insurance business in Germany is a subject which may well attract general attention just now; and we find some interesting facts concerning it in a paper by Frank A. Vanderlip in the April "Scribner's." The German Government is annually collecting over $130,000,000 in insurance dues of one sort or another, and paying out nearly as much to beneficiaries. These collections are made from over 17,000,000 individuals, and are disbursed to nearly as great a number; yet less than eight and one-half per cent. of the total income is used up in administration and 91½ per cent. is actually paid to the insured. As Mr. Vanderlip says:

> The cost of administration of American insurance funds makes sorry comparison with the expense of administration in Germany. * * * A showing like this, so greatly in favor, apparently, of the economy of government administration, would seem to raise the inquiry as to whether Germany has not found a better plan for the administration of insurance funds than we have evolved in this country.

Passing from this subject, Mr. Vanderlip takes up the question of Employers' Liability insurance as developed in the United States in contrast with the German system of insurance against accident, and as he well says, the comparison is anything but reassuring to our national vanity. He also has high praise for the German state railways as compared with the privately-owned railways of England.

An interesting plan for solving the railroad problem is proposed by Senator Newlands of Nevada in the "North American Review." He would substitute National State railway control at every point, would consolidate all the railroads in one organization and would have rates of fare and freight so fixed as to pay a dividend of 4% and no more on the actual present valuation of the railway property. It would require considerable study of such a proposition to see how a practically workable system could be developed.

"The Remaking of Boston" is the subject of an interesting and finely illustrated paper by Rollin Lynde Hart in the April "World's Work." In "Everybody's," for April, appears the second of a series of articles on the Beef Trust by Charles Edward Russell. The articles are excellently written and deserve careful reading.

### Publications Received.

ALTERNATING CURRENT MACHINERY.—By William Esty, S. B., M. A., Head of Department of Electrical Engineering, Lehigh University. Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. 412; plates, and 380 figures in the text. $3.75.

AMERICAN TELEPHONE PRACTICE.—By Kempster B. Miller. Fourth Edition, Enlarged and Entirely Rewritten. New York: McGraw Publishing Co. Cloth; 7 × 10½ ins.; pp. 888; 643 figures in the text. $4, net.

THE AUTOMOBILE POCKETBOOK.—A Compendium of the Gasoline Automobile. By E. W. Roberts, M. Am. Soc. M. E., Author "The Gas-Engine Handbook," "On Marine Motors and Motor Launches," "Gas Engines and Their Troubles," Etc. Cincinnati: The Gas Engine Publishing Co. Leather; 3½ × 5¼ ins.; pp. 329; 51 figures in the text. $1.50.

THE BERLIN-ZOSSEN ELECTRIC RAILWAY TESTS OF 1903.—A Report of the Test Runs Made on the Berlin-Zossen Railroad in the Months of September to November, 1903. Translated from the German by Franz Welz, E. E. With an Introduction Discussing the General Subject of Train Resistance, by Louis Bell, Ph. D., M. Am. Inst. E. E. New York: McGraw Publishing Co. Cloth; 8 × 11½ ins.; pp. xvi. + 100; tables, 38 plates, and 18 text illustrations. $3, net.

CENTRIFUGAL FANS.—A Theoretical and Practical Treatise on Fans for Moving Air in Large Quantities at Comparatively Low Pressures. By J. H. Kinealy, M. Am. Soc. M. E., Formerly Professor of Mechanical Engineering at Washington University, St. Louis. New York: Spon & Chamberlain. London: E. & F. N. Spon, Ltd. Leather; 4 × 6¾ ins.; pp. 206; 22 tables and 33 figures in the text. $5, net.

A COMPLETE CLASS-BOOK OF NAVAL ARCHITECTURE.—Practical, Laying Off, Theoretical. By W. J. Lovett, Lecturer on Naval Architecture at the Belfast Municipal Technical Institute. With Numerous Illustrations and Almost 200 Fully Worked-out Answers to Recent Board of Education Examination Questions. London, New York and Bombay: Longmans, Green & Co. Cloth; 5½ × 8¾ ins.; pp. 283. 7s. 6d., net; American price, $2.50.

DEVELOPMENT OF THE LAKE SUPERIOR COPPER MINES DURING 1904.—By Arthur L. Carnahan, Mining Editor of the Daily Mining Gazette, Houghton, Mich. Calumet, Mich.: The Author. Paper; 6 × 10 ins.; pp. 37. 50 cts.

ELECTRIC RAILWAYS.—Theoretically and Practically Treated. By Sydney W. Ashe, B. S., Department of Electrical Engineering, Polytechnic Institute of Brooklyn, Assoc. M. Am. Inst. E. E.; and J. D. Kelley, Electrical Engineering Department, New York Central Railroad. New York: D. Van Nostrand Co. Cloth; 5½ × 8 ins.; pp. 285; six folding plates and 172 text illustrations. $2.50.

EXPERIMENTAL RESEARCHES ON THE FLOW OF STEAM THROUGH NOZZLES AND ORIFICES.—To Which is Added a Note on the Flow of Hot Water. By A. Rateau, Engineer of the Mining Corps, Professor in the Ecole Supérieure des Mines, Paris. Reprint from the "Annales des Mines," January, 1902. Authorized Translation by H. Boyd Brydon. New York: D. Van Nostrand Co. Cloth; 5 × 7½ ins.; pp. 76; tables, four figures in the text and four folding plates. $1.50 net.

GAS ENGINE DESIGN.—By Charles Edward Lucke, Ph.D., Mechanical Engineering Department, Columbia University, New York City. New York: D. Van Nostrand Co. Cloth; 6 × 9½ ins.; pp. 254; tables, and 145 figures in the text. $3 net.

GAS ENGINES AND PRODUCER GAS PLANTS.—A Practical Treatise Setting Forth the Principles of Gas Engines and Producer Design, the Selection and Installation of an Engine, Conditions of Perfect Operation, Producer Gas Engines and Their Possibilities, the Care of Gas Engines and Producer Gas Plants, with a Chapter on Volatile Hydrocarbon and Oil Engines. By R. E. Mathot, M. E., Member of the Societe des Ingenieurs Civils de France. Translated from Original French Manuscript by Waldemar B. Kaempffert. With a Preface by Dugald Clerk, M. Inst. C. E., F. C. S. New York: The Norman W. Henley Publishing Co. Cloth; 6 × 9 ins.; pp. 314; 152 figures in the text. $2.50.

THE MECHANICAL ENGINEERING OF COLLERIES.—By T. Campbell Futers. Vol. I.: (1) Boring. (2) Shaft Sinking. (3) Surface Arrangements. (4) Shafts and Head Gears. London: The Chichester Press. Paper; 7½ × 9¾ ins.; pp. 128; 294 illustrations. 7s. 6d.; $3 in America.

THE PRINCIPAL PROFESSIONAL PAPERS OF DR. J. A. L. WADDELL, CIVIL ENGINEER.—Edited by John Lyle Harrington, Civil Engineer. New York: Virgil H. Hewes, 245 West 107th St. Cloth; 6 × 9½ ins.; pp. 991; folding and other plates, and text illustrations. $5.

THE SEWAGE PROBLEM.—A Review of the Evidence Collected by the Royal Commission on Sewage Disposal. By Arthur J. Martin, Assoc. M. Inst. C. E. London: The Sanitary Publishing Co., Ltd. New York: D. Van Nostrand Co. Cloth; 5½ × 7½ ins.; pp. 363. 8s. 6d. net; American price, $3.50 net.

GENERATOR,- KRAFTGAS- UND DAMPFKESSEL-BETRIEB.—In Bezug auf Wärmeerzeugung und Wärmeverwendung. Eine Darstellung der Vorgänge, der Untersuchungs- und Kontrollmethoden bei der Umformung von Brennstoffen für den Generator-, Kraftgas- und Dampfkessel-Betrieb. By Paul Fuchs. Second Edition of "Die Kontrolle des Dampfkesselbetriebes." Berlin: Julius Springer. Leather; 6½ × 8½ ins.; pp. 188; 42 figures in the text. 5 marks.


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